Social and Ecological Responses to Climate Change and Land-use Effects on Water Availability: Contrasting Resilience Among Major River Basins of the US and Canada

Final Report

Convenor(s)

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5. Mark Williams, U. Colorado, Niwot Ridge (NWT) <markw@culter.colorado.edu> (unable to attend)

Goals and Background work

To understand climate change effects on ecosystems and humans, it is essential to connect long-term data on climate and water yield in headwater basins to water availability as experienced by water users. This requires an understanding of ecological and social resilience to climate change and associated changes in water availability. The goal of this workshop was to test hypotheses (identified in a 2010 working group, see attached report) about ecological and social resilience of the water cycle to climate change and land use change by examining analyses of trends in ten major river basins in the US and Canada. The workshop aimed to define socio-ecological resilience and vulnerability as they relate to water resources. In preparation for the workshop, we synthesized existing records of streamflow and climate from LTER, USFS, and USGS sites with population data at the partial block level from the US Census, extending datasets in EcoTrends and clim/hydroDB. This workshop addressed the “Inland Climate Change: Social and Ecological Sensitivities and Responses” goal of the LTER Decadal plan. It was consistent with the network science plan’s objectives to explore the connections between ecosystems and human society, in that it specifically addresses the connections between climate-change impacts in the headwaters (which are the sites of many LTERs) and human populations in the lowlands (often, cities).

The proposed synthesis workshop built on findings and projects underway from a working group at the 2009 LTER All-Scientists meeting and a synthesis working group held November 4-7, 2010 at Sevilleta LTER (Hydrologic effects from ecosystem responses to climate change and land use change). Our first workshop (Nov 2010) established the rates of climate change and water yield responses in headwater basins and identified additional datasets and testable hypotheses to quantify and compare ecological and societal resilience. The second synthesis workshop focused on ecological and societal resilience, including greater representation by social scientists (see list of participants below).

Timing

The workshop was held at Sevilleta National Wildlife Refuge from Nov 16-19, 2011. Twenty-four people attended, including nine graduate students and postdocs, and an additional five people attended or contributed remotely.

Participants (*participated remotely) (+graduate student or postdoc)

1	Julia Jones	Oregon State U.	AND	jonesj@geo.oregonstate.edu		X
2	Kathleen Miles+	Oregon State Univ.	AND	kathleen.m.moore@gmail.com		X
3	Hannah Gosnell	Oregon State Univ.	AND	gosnellh@geo.oregonstate.edu		X
4	Evan Miles+	Oregon State Univ.	AND	milese@science.oregonstate.edu		X
5	Tamara Harms	University of Alaska	BNZ	<tamara.harms@alaska.edu>		X
6	Irena Creed	U Western Ontario	Canada	icreed@uwo.ca		X
7	Adam Spargo	U Western Ontario	Canada	<aspargo@uwo.ca>		X
8	Nancy Grimm	NSF	CAP	NBGRIMM@asu.edu		X
9	Rebecca Hale+	ASU	CAP	<rlhale@asu.edu>		X
10	Robert Warren+	Yale Univ.	CWT	hexastylis@gmail.com		X
11	Chelcy Ford	USFS - Coweeta Hydrologic Lab	CWT	<crford@fs.fed.us>		X
12	Amartya Saha+	Florida Intl University	FCE	riparianbuffer@gmail.com		X
13	Mary Beth Adams	Fernow	FER	Adams, Mary <mbadams@fs.fed.us>		X
14	Sylvia Schaefer+	University of Georgia	GCE	Sylvia@uga.edu		X
15	John Campbell	USFS - Hubbard Brook EF	HBR	jlcampbell@fs.fed.us		X
16	Emery Boose	Harvard Forest	HFR	boose@fas.harvard.edu		X
17	Agustin Robles+	ASU	JRN	aroblesm@asu.edu		X
18	Alan Covich	Univ Georgia	LUQ	alanc@uga.edu		X
19	Stephen Sebestyen	USFS - Marcell EF	MAR	ssebestyen@fs.fed.us		X
20	Eric Booth+	University of Wisconsin	NTL	Eric Booth <egbooth@wisc.edu>		X
21	Rob Stewart+	University of New Hampshire	PIE	<robstewart802@gmail.com>		X
22	Cliff Dahm	Univ New Mexico	SEV	<cliff.dahm@deltacouncil.ca.gov>	Local	
23	Melinda Harm				Local	
24	Benson	Univ New Mexico	SEV	mhbenson@unm.edu		
25	Michael Gooseff	Penn State University	ARC,MCM	mgooseff@engr.psu.edu		X
26	Kendra	Oregon State	AND	hatcheke@science.oregonstate.e		

5	Hatcher *	Univ.		du
2		Arizona State		
6	Kelli Larson*	Univ.	CAP	kelli.larson@asu.edu
2		USFS - Fraser		
7	Kelly Elder*	Exper Forest	FRA	kelder@fs.fed.us
2	Mark			
8	Williams*	U. Colorado	NWT	<markw@culter.colorado.edu>
2		Central New Mexico Community		
9	Asa Stone*	College	SEV	astone10@cnm.edu

Activities

Participants in the workshop engaged in several sets of activities.
(1) a session addressing Vulnerability, sustainability, and risk for water included presentations by Kelli Larson, Hannah Gosnell, and Nancy Grimm. These presentations led to group discussions of concepts including Tradeoffs, ecosystem services, Perception of risk, Vulnerability vs. socio-ecological systems, Common and unique vulnerabilities; Exposure, sensitivity, adaptive capacity; Vulnerability and resilience; Sustainability science; Governance; Risk: likelihood and consequence; and Complexity, emergent behavior, path dependence. This session included breakout groups to address the question: Vulnerability, resilience, risk, and sustainability – how to measure and study for freshwater systems?

(2) a session addressing Synthesis of long-term trends at headwater sites. This included presentations of the work of Kendra Hatcher, Evan Miles, and Kathleen Miles (streamflow trends); Budyko curves (Irena Creed, Adam Spargo); and streamflow correlations with climate indices (Robert Warren).

(3) A session presenting Population trends and streamflow trends in large basins, including presentations of the work of Kendra Hatcher and Evan Miles. Spatial population trends and streamflow trends along the river were presented for these basins:
Willamette-(AND) HJ Andrews-29,000 km^2
Salt- (CAP) Central Arizona Phoenix- 34,250 km^2
Rio Grande- (SEV, JRN) Sevilleta-49,400 km^2
Boulder Creek- (NWT) Niwot Ridge-1160 km^2
Upper Mississippi- (MAR, NTL) Marcell, North Temperate Lakes-95,000 km^2
Merrimac- (HBR,PIE) Hubbard Brook-12,000 km^2
Connecticut- (HFR) Harvard Forest-15,550 km^2
Tennessee- (CWT) Coweeta-55,425 km^2
Monongahela- (FER) Fernow-19,000 km^2
Upper Colorado-(FRA) Fraser-9,680 km^2

(4) a session of breakout groups to define research topics for addressing socio-ecological resilience of water in large river basins.

Products

1) Julia A. Jones, Irena F. Creed, Kendra L. Hatcher, Robert J. Warren, Mary

Beth Adams, Melinda H. Benson, Emery Boose, Warren A. Brown, John L. Campbell, Alan Covich, David W. Clow, Clifford N. Dahm, Kelly Elder, Chelcy R. Ford, Nancy B. Grimm, Donald L. Henshaw, Kelli L. Larson, Evan S. Miles, Kathleen M. Miles, Stephen D. Sebestyen, Adam T. Spargo, Asa B. Stone, James M. Vose, Mark W. Williams. In press. Ecosystem Processes and Human Influences Regulate Streamflow Response to Climate Change at Long-Term Ecological Research Sites. BioScience.

2) Pre-proposal to NSF Sustainability Research Network competition, submitted Dec 5. 2011.
Sustainable Freshwater Systems: Headwaters to Households. 50 co-investigators including workshop participants.

3) manuscripts in preparation: (a) Creed, I.F. et al. Budyko curves and water resources at long-term ecological research sites. (b) Warren, R.J. et al. Streamflow trends and climate indices. (c) Jones, J.A., K.L. Hatcher et al. Population trends and streamflow trends in large river basins of the US.